

# Physics

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(Chapter 1) (Electric Charges and Fields)  
(Class 12)

## Question 1.1:

What is the force between two small charged spheres having charges of  $2 \times 10^{-7}\text{C}$  and  $3 \times 10^{-7}\text{C}$  placed 30 cm apart in air?

## Answer 1.1:

Repulsive force of magnitude  $6 \times 10^{-3}\text{N}$

Charge on the first sphere,  $q_1 = 2 \times 10^{-7}\text{C}$

Charge on the second sphere,  $q_2 = 3 \times 10^{-7}\text{C}$

Distance between the spheres,  $r = 30\text{cm} = 0.3\text{m}$

Electrostatic force between the spheres is given by the relation  $F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$

Where,  $\epsilon_0$  = Permittivity of free space and  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{Nm}^2\text{C}^{-2}$

Therefore, force  $F = \frac{9 \times 10^9 \times 2 \times 10^{-7} \times 3 \times 10^{-7}}{(0.3)^2} = 6 \times 10^{-3}\text{N}$

Hence, force between the two small charged spheres is  $6 \times 10^{-3}\text{N}$ . The charges are of same nature. Hence, force between them will be repulsive.

## Question 1.2:

The electrostatic force on a small sphere of charge  $0.4\mu\text{C}$  due to another small sphere of charge  $-0.8\mu\text{C}$  in air is  $0.2\text{N}$ .

(a) What is the distance between the two spheres?

(b) What is the force on the second sphere due to the first?

## Answer 1.2:

(a) Electrostatic force on the first sphere,  $F = 0.2\text{N}$

Charge on this sphere,  $q_1 = 0.4\mu\text{C} = 0.4 \times 10^{-6}\text{C}$

Charge on the second sphere,  $q_2 = -0.8\mu\text{C} = -0.8 \times 10^{-6}\text{C}$

Electrostatic force between the spheres is given by

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

Where,  $\epsilon_0$  = Permittivity of free space and  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{Nm}^2\text{C}^{-2}$

Therefore,

$$r^2 = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{F} = \frac{0.4 \times 10^{-6} \times 8 \times 10^{-6} \times 9 \times 10^9}{0.2} = 144 \times 10^{-4}$$

$$\Rightarrow r = \sqrt{144 \times 10^{-4}}$$

$$= 12 \times 10^{-2}$$

$$= 0.12\text{m}$$

The distance between the two spheres is  $0.12\text{m}$ .

(b) Both the spheres attract each other with the same force. Therefore, the force on the second sphere due to the first is  $0.2\text{N}$ .

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**Yan Bai**



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## **Table of Contents Physics Chapter 12 Answers**

1. Understanding the eBook Physics Chapter 12 Answers
  - The Rise of Digital Reading Physics Chapter 12 Answers
  - Advantages of eBooks Over Traditional Books
2. Identifying Physics Chapter 12 Answers
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Physics Chapter 12 Answers
  - User-Friendly Interface
4. Exploring eBook Recommendations from Physics Chapter 12 Answers
  - Personalized Recommendations
  - Physics Chapter 12 Answers User Reviews and Ratings
  - Physics Chapter 12 Answers and Bestseller Lists
5. Accessing Physics Chapter 12 Answers Free and Paid eBooks
  - Physics Chapter 12 Answers Public Domain eBooks
  - Physics Chapter 12 Answers eBook Subscription Services
  - Physics Chapter 12 Answers Budget-Friendly Options

6. Navigating Physics Chapter 12 Answers eBook Formats
  - ePub, PDF, MOBI, and More
  - Physics Chapter 12 Answers Compatibility with Devices
  - Physics Chapter 12 Answers Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Physics Chapter 12 Answers
  - Highlighting and Note-Taking Physics Chapter 12 Answers
  - Interactive Elements Physics Chapter 12 Answers
8. Staying Engaged with Physics Chapter 12 Answers
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Physics Chapter 12 Answers
9. Balancing eBooks and Physical Books Physics Chapter 12 Answers
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Physics Chapter 12 Answers
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Physics Chapter 12 Answers
  - Setting Reading Goals Physics Chapter 12 Answers
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Physics Chapter 12 Answers
  - Fact-Checking eBook Content of Physics Chapter 12 Answers
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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